BUILDING DREDGING EQUIPMENT: BEST PRACTICES ACROSS THE GLOBE

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ABSTRACT

In the last decade tremendous changes have taken place in the dredging market. As a result of the booming global economy especially in the South East Asian region (e.g. China, India, Singapore, Malaysia) large infrastructure investments were made and this trend continues unabated today.

Globalization of the world economy has resulted in an enormous increase in goods being transported between the different continents. This development in turn demands permanent improvement of the seaways, coasts and estuaries, as well the port facilities and the respective inland waterways. These factors have been the driving force behind the extensive increase in capital and maintenance dredging around the globe not to mention the immense capital dredging work executed in the Gulf.

This global growth in dredging projects has significantly boosted investment in the worldwide dredging fleet as well as in the dredging equipment market. It is interesting to see, that this fleet enlargement is not only taking place at the market dominating European and American dredge contractors. It is also happening in an ever-increasing way at local dredge contractors in the countries where the large infrastructure projects are been realized. For reasons of high cost effectiveness both dredge new builds and dredge equipment manufacture are increasingly being carried out at shipyards located directly in the so-called "low cost" countries.

This paper explains by means of several examples, how dredging equipment suppliers can act nowadays in this increasing global market, to combine years of in-depth dredging expertise with local building power close to the relevant customer anywhere in the world. It shows how an exchange of know-how is possible while at the same time protecting one’s own key intellectual property. Proof of this lies with real-life examples such as the largest ever built trailing suction hopper dredge (TSHD) in Japan, the largest ever built TSHD in China and the largest ever built cutter suction dredge (CSD) in India. On the basis of a TSHD built in the USA the paper suggests how a dredge equipment supplier can work around artificial boundaries put up by the market such as the Jones Act.

Keywords: Capital dredging, maintenance dredging, trailing suction hopper dredge, cutter suction dredge, Jones Act

INTRODUCTION

Although the dredging business represents a niche market in global terms, it exerts – especially in recent times – substantial influence on the world economy. On examining the increase in dredging projects around the globe in the last decade and their impact on the economies of the involved regions and countries, it can be seen that dredging business plays one of the key roles in worldwide industrial development. As one of the results of this boost in the dredging market, a growth in the annual turnover of the dredger new build and repair sectors from 3-5 to about 8-10 % could be observed in the last decade.

IMPACTS ON LATEST DREDGING BUSINESS DEVELOPMENTS

In recent years, the worldwide economy has been characterized by an increased distribution of production (outsourcing) in conjunction with an enlarged exchange of all kinds of industrial and agricultural goods, and with a huge worldwide growth in raw material and energy consumption.

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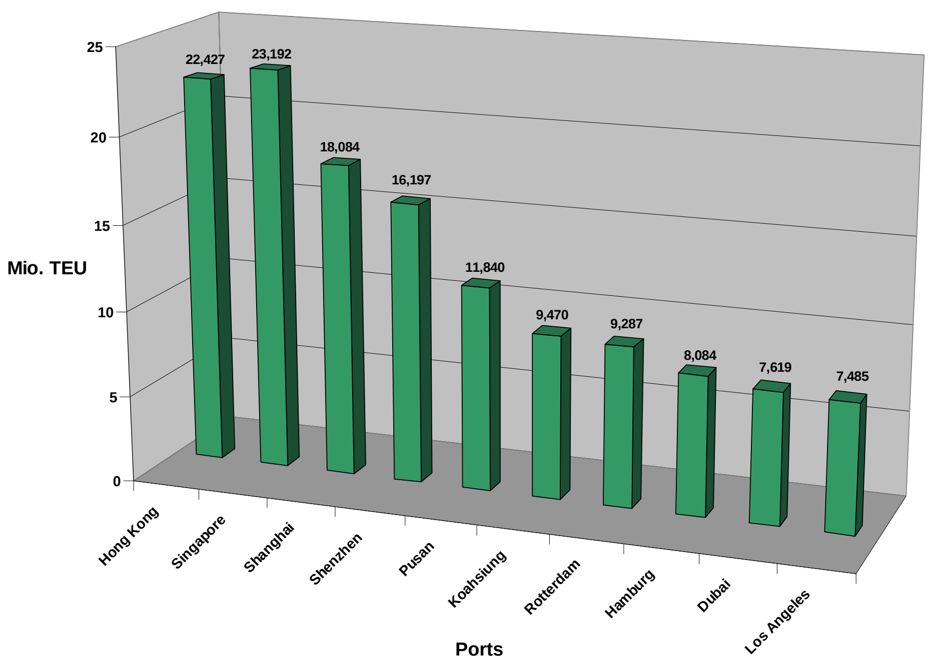
In the same manner, the globally linked production processes and the just-in-time/tailor-made supply chains call for improved transport solutions. Based on freight volumes shipping is by far the leading means for international transport. Due to these changes, the importance of global transport to the global economy is continuously increasing. This is evident from the recent exponential growth in worldwide container traffic.

Development of Global Container Handling

In 2005 more than 350 Million TEU (**T**wenty Foot **E**quivalent **U**nit, one TEU = one 20' Standard Container) were transported on the seaways worldwide. It is expected that by the year 2014 this amount will have doubled. Especially China is the one of the major forces behind this container boom. Since China joined the WTO (World Trade Organization) in 2001, the growth rate of global sea transport has been in double digits.

As an example, the port of Hong Kong with yearly about 20 Mill TEU was for more than seven years, the number one in the world in container handling. In recent years, global competition in the container handling business between the ports has become more and more strong. Besides Hong Kong the container terminals of Singapore, Shenzhen, Shanghai and Pusan have become increasingly important while the European ports have lost there dominant position.

Table 1. Port ranking in container handling in the year 2005, Federal Office of Statistics, FRG, Mai 2006.



Introduction of Ultra and Post-panama-class Container Vessels

The increase in overall annual global container handling has been accompanied by an associated increase in the number of containers carried by each vessel, achieved by the introduction of new bigger and larger container vessels. With the launch of the so-called ultra and post-panama container vessel class a new standard for global shipping was set. In this connection the new ship builds M/S EMMA MAERSK of shipping company A.P. Moller-Maersk Group and M/S CSCL LE HAVRE of shipping company Danaos Shipping should be mentioned.

Figure 1. M/S EMMA MAERSK at the outfitting quay at Odense Steel Shipyard.

M/S EMMA MÆRSK is one of the very large container ships built by Odense Steel Shipyard Ltd. The ship has a capacity of about 11,000 twenty-foot containers. The main particulars are as follows:

- Length over all 397.0 metres
- Breadth 56.0 metres
- Draught 15.5 metres

The vessel is driven by a 14-cylinder main engine developing a propulsion power of 80,000 kW. It is also equipped with five diesel engines supplying a combined power of 20,700 kW and a combined gas/steam turbine generator of 8,500 kW driven by the main engine exhaust.

Figure 2. M/S CSCL LE HAVRE at entrance of Hamburg harbour.

M/S CSCL LE HAVRE belongs to the so-called post-panama vessel class. It has a capacity of about 9,850 twenty-foot containers and was built at the South Korean Shipyard Samsung Heavy Industries. The main particulars are as follows:

- Length over all 336.7 metres
- Breadth 45.6 metres
- Draught 14.5 metres

Maintenance, Port Construction and Land Reclamation Dredging Projects

Economic sea transport is inherently restricted to the links between the continents and to the availability of efficient pre and post sea transports facilities, i.e. the quality of port infrastructure. In order to handle the rapid increase in container transport, large investments in port facilities and sea ways have taken placed. As part of these investments, a number of new waterway maintenance projects as well as land reclamation projects have already been realised while others are in process around the globe.

According to the definition of the International Association of Dredging Companies (IADC) there are three different categories of dredging projects: Maintenance dredging. Capital dredging and Remedial dredging

In maintenance dredging projects the removal of siltation from water channels, harbour basins and port entrances is involved in order to maintain the required navigation depth of the waterways.

Typical examples here fore are the ongoing dredging activities at the mean European sea hubs, such as at the Hamburg Port entrance on the river Elbe/Germany, at the port entrance of Rotterdam Harbour/The Netherlands and in the Port of Antwerp/Belgium. Due to the natural siltation process these waterways have to be continuously dredged to maintain a navigable depth.

Capital dredging can be defined as the removal of huge amounts of soil or rock from the sea floor in order to create new or improved facilities such as a harbour basin, a deeper navigation channel, a lake, or an area of reclaimed land for industrial or residential purposes.

Current capital land reclamation projects are – among others-:

- Al Raha Beach project, Abu Dhabi
- Wave Muscat landmark project, Oman
- Offshore island Pearl-Qatar, Qatar
- Palm islands project, Dubai

Figure 3. Palm islands project, Dubai.

Current major capital port and harbour dredging projects are:

- Extension of Rotterdam Port – Project Maasvlakte II, The Netherlands
- New navigation channel St. Petersburg Port, Russia
- Building of new harbor Tangier Med, Gibraltar
- Deepening of Jawaharlal Nehru Port Mumbai, India
- Deepening and widening of Columbia river entrance
- Deepening and widening Santos port entrance, Basil
- Building of LNG harbour facilities at Pampa Melchorita, Peru
- Panama Canal expansion

The Panama Canal Project

With the new Panama Canal project the creation of a new navigation channel and the widening and deepening of the existing canal is planned. Additionally the building of a third set of locks capable for handling 12,000 TEU container vessels, Suezmax tankers and Capesize bulkers is planned. After completion of the project, the canal's capacity will be double from today's 330 Million tons to about 600 Million tons. The realisation of the project requires among others dredging work of about 50 Million m³ and the deepening and widening of the Atlantic and Pacific entrances to the Canal.

Figure 4. View to Gaillard Cut of Panama Canal.

In addition to the above-mentioned capital dredging projects, which are being realized with conventional dredging equipment, a new era in capital dredging is arising. The introduction of an innovative generation of powerful rock cutting dredgers and the so-called mega-size hopper dredgers with higher cost efficiency open the way for huge waterway projects, which were previously inconceivable. In this regard the Sethusamudram channel project between India and Sri Lanka and the Thai Canal (formerly known as Kra Canal) between Southern Thailand and Myanmar are mentioned.

The Sethusamudram Ship Channel Project

The coast of India does not have a continuous navigation channel connecting the east and west coasts. Currently the ships coming from the west coast of India and other western countries with destinations on the east coast of India, Bangladesh, and China etc have to navigate around the Sri-Lankan coast. The Palk Strait between India and Sri Lanka is shallow and not sufficient for the movement of ships. This is due to the presence of a shallow region known as Adam's bridge, located southeast of Rameswaram near Pamban, which connects to the Talimannar Coast of Sri Lanka.

A British Commander A.D. Taylor of the Indian Marine originally proposed the channel project in 1860. Now with the Sethusamudram channel project a ship channel across the Palk straits between India and Sri-Lanka will be established. This new channel allows ships sailing between the east and west costs of India to have a direct passage through India's territorial waters, instead of having to circumvent Sri-Lanka. With the completion of the channel the sailing time between India's west and east coast and vice versa will be reduced by 30 hours.

Figure 5. Chart of Sethusamudram channel project.

The project involves dredging work of about 82.55 million cubic meters over a length of 89 kilometers. Two channels will be created with one at the north entrance and one at the south entrance to the strait. To facilitate two-way navigation the width of the proposed channels at the sea-bed level is 300 meters.

The Thai Canal Project

The idea to build a canal across Southern Thailand's narrow isthmus dates back to the earliest seventies of the 17th century when the Thai King Narai the Great asked the French engineer de Lamar to survey the possibility of building a waterway in order to connect Songkhla with Marid (now Myanmar). Due to the limitations of the dredging methods available at that time the project was abandoned.

In the 20th century the idea resurfaced several times with a change in the preferred route to somewhere in Southern Thailand, to connect the Bandon Bay near Surat Thani with Phangnga. The idea of the Thai Canal has once again become of great interest because of the increasing sea traffic in the Strait of Malacca. The strait is characterized by a 1,000 kilometer long and narrow passage, which is less than 2.5 kilometers at the narrowest and has a depth of 25 meters at its shallowest. It is heavy used by oil tankers and bulk carriers. Some 80 percent of Japan's oil supplies pass through this strait.

Figure 6. Map of Kra Canal route.

LATEST ORDERS IN DREDGING FLEET OF LEADING INTERNATIONAL DREDGING COMPANIES

As a result of the global boom in port construction and land reclamation dredging works, the major international dredging contractors have in recent years engaged in several fleet renewal and fleet expansion programs. New technologies and enhanced designs have improved dredging and sailing performance tremendously and have reduced the costs per dredged cubic meter of soil. The following dredge new builds are leading examples of this development:

CSD D'Artagnan

The Cutter Suction Dredger D'Artagnan is one of the most powerful dredgers of its kind. Due to its special design and equipment on board the vessel is able to dredge/cut hard rock materials in difficult sea conditions and is executed as a self propelled ocean-going CSD.

Figure 7. CSD D'Artagnan on sea-voyage.

Main particulars:

• Length over all	123.80	metres
• Breadth	25.20	metres
• Draught	5.50	metres
• Dredging depth	35.0	metres
• Cutter power	6,000	kilo Watts
• Total installed power	28,200	kilo Watts

CSD Kaerius / CSD Hondius

Figure 8. CSD Hondius on slipway.

These two Cutter Suction Dredgers are sister vessels and are being built for the Jan de Nul Group. Main particulars of these Cutter Suction Dredgers are:

- Length over all 86.2 metres
- Breadth 19.0 metres
- Draught 2.95 metres
- Dredging depth 20.0 metres
- Cutter power 1,500 kilo Watts
- Total installed power 8,460 kilo Watts

TSHDs for Boskalis

In November 2006 dredge contractor Royal Boskalis Westminster has ordered two mid-size trailing suction hopper dredgers of 5,600 m³ each. These ships, which were specially designed to dredge and transport sand and silt, will be put into service by the end of 2008 and 2009, respectively.

Figure 9. Artist impression of new 5,600 m³ TSHD.

TSHD Marieke

The Trailing Suction Hopper Dredger Marieke is the second in a series of three similar medium-size hopper dredgers built in recent times for the Belgian group (DEME). The main dimensions enable the vessel to operate in shallow waters on a world-wide basis, which has previously been the operational area of smaller hopper dredgers with a loading capacity of max. 3,000 m³. A highlight of dredger's design is the integrated one-man navigation and dredging control desk.

Figure 10. TSHD Marieke on rain bowing service.

Main particulars:

• Length over all	97.50	metres
• Breadth	21.60	metres
• Draught loaded	7.10	metres
• Dredging depth	33.00	metres
• Hopper capacity	5,600	cubic metres
• Loading capacity	8,100	tons
• Total installed power	6,776	kilo Watts

TSHD No. 8023 and 8030

These trailing suction hopper dredgers will be delivered for the Jan de Nul Group in the year 2008. The special feature of these two medium size hopper dredgers is the significantly reduced draft enabling them to work in shallow waters.

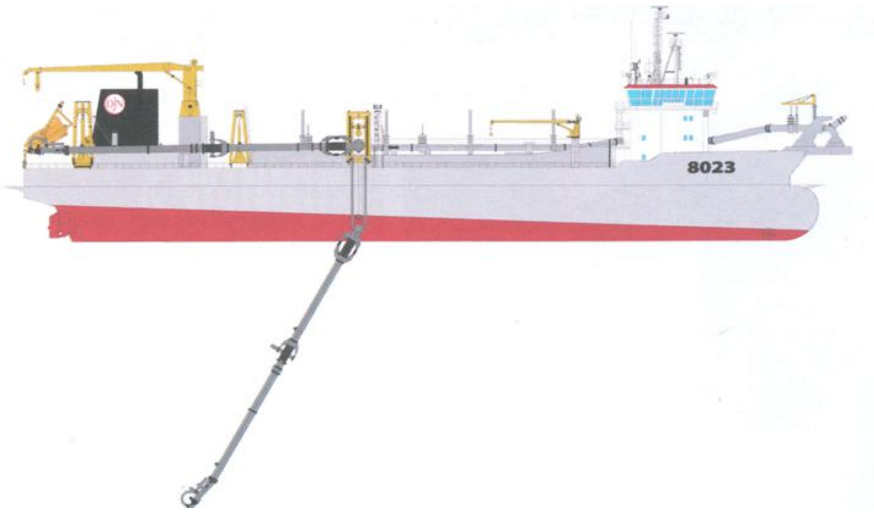


Figure 11. Artist impression of TSHD No. 8023.

Main particulars:

- Length over all 104.25 metres
- Breadth 23.00 metres
- Draught loaded 8.15 metres
- Dredging depth 46.40 metres
- Hopper capacity 7,500 cubic metres
- Loading capacity 11,800 tons
- Total installed power 8,975 kilo Watts

Mega size TSHD for Jan de Nul

In January 2007 the Jan de Nul Group has announced the order of a new mega trailing suction hopper dredger with a carrying capacity of 46,000 m^3. The vessel will be built and delivered in the year 2008.

Figure 12. Artist impression of new mega size 46,000 m³ TSHD

Main particulars:

- Length over all 223.00 metres
- Breadth 41.00 metres
- Draught loaded 15.15 metres
- Dredging depth 155.00 metres
- Hopper capacity 46,000 cubic metres
- Loading capacity 78,000 tons
- Total installed power 41,500 kilo Watts

CHANCES FOR DREDGE EQUIPMENT SUPPLIERS IN THE GROWING GLOBAL DREDGING MARKET

Building Dredgers in Developing Countries According to Latest Available Technology

When looking at the need for maintenance and capital dredging needs to safeguard future economic development and growth of ports worldwide, it is only logical to recognize the advantage of increasing local fleet capacities to strengthen national independence from multinational dredge operators.

By using nationally owned local shipyards and importing foreign dredging technology, developed and supplied by international dredge equipment suppliers such as VOSTA LMG, developing countries have been able to establish their own dredging fleet. In doing so they are now in a position to cope with the future economic demands for dredging activities being set by national industry.

These so called “low cost” countries have been able to take advantage of a lower labour cost factor, minimising the requirement for foreign currency, to build cost effective dredgers. With this combination the developing countries have generated access to first class technology at best and affordable prices.

Back in the 1980's VOSTA LMG had already building high technology dredges on foreign yards and now has many years of experience in this area. It is not surprising to find experienced and well-equipped shipyards around the globe, even in developing countries. However, these yards must have certain qualifications to be suitable for building technically demanding vessels such as dredges. Important requirements are, among others:

- Shipbuilding facilities, which allow shipbuilding within a moderate time frame
- Acceptable shipbuilding references as such
- Work- and paint-shops of adequate size and with suitable installations
- Shipyard logistics and manpower of sufficient quality and quantity
- Quality control and ISO certifications according to job-requirements
- Experience in co-operating with institutions such as GL, BV, LRS, ABS, etc.

For example, shipyards involved in navy shipbuilding have good references to be selected to build dredges. However the increased administration at those yards associated with military projects must not hinder smooth working operations and the tight time schedule required for building a dredge. The yard must be willing to adapt to this requirement and of course the owner must also accept the facility.

Once the yard has been carefully selected the triangular cooperation between the shipyard, the dredge equipment supplier and the owner goes smoothly. A must however, is the mutual acceptance and tolerance of different nationalities, human characters, cultures and societies.

When establishing a relationship between a shipyard and a dredge designer the aim is to forge a long term cooperation to make use of the newly generated expertise by the yard and to safeguard the yards and dredge equipment supplier’s interests for the future. The benefits of such cooperation for both the yard and the shipbuilder’s home country are obvious. The end-user receives a state of the art dredge of the latest available design where the dredging technology has been imported and implemented at the yard.

Low cost manufacturing is reflected in a competitive sales price for the dredge. The delivery time is adequately timed and mutually agreed upon whilst the necessary shipbuilding and performance guarantees are of international standards and very transparent to the owner. The yard is able to develop extensive know-how of dredge building with little risk and opens itself for new fields of activities.

Latest References of State-of-the-art Dredgers Being Built at Yards in Developing Countries

The combination of smart sourcing of materials, standardized solutions in components and the latest technology engineered using advanced systems has led to many industry-breaking dredges being built outside Europe in recent years. This is proven by the following two examples:

TSHD "Shen Hua", built China

Figure 13. TSHD "Shen Hua" on sea voyage.

In January 2003 VOSTA LMG received an order from Hudong Zhonghua Shipyard in China for the design and supply of all dredging components for a Trailing Suction Hopper Dredge. The owner of the dredge is the Chinese Harbor Authority Huanghua Port and the vessel, named "Shen Hua", is employed performing continuous dredging work to maintain the required depth of the entrance to Huanghua Port. This was the initial reason for the Board of Management of Shenhua Group to invest in their own dredger. Huanghua Port, located on the North East Coast of China, belongs to the Shenhua Group and is the main hub for the worldwide transport of coal being excavated in the mines located in the northern part of China.

Main particulars:

- Length over all 122.00 metres
- Breadth 22.00 metres
- Draught loaded 6.90 metres
- Dredging depth 26.00 metres
- Hopper capacity 5,000 cubic metres
- Loading capacity 0,000 tons
- Total installed power 10,870 kilo Watts

The order covered the complete basic engineering package and the delivery of the dredging components. As has repeatedly happened in the past, VOSTA LMG also had the complete technical responsibility for this vessel. The dredger itself was built according to the latest developments in dredging technology available for medium-size hopper dredgers.

To safeguard the know-how of VOSTA LMG all knowledge-intensive shipbuilding, machinery and dredging equipment engineering work was executed solely by VOSTA LMG with only the final basic design provided to the shipyard as a complete package. Amongst others the complete hull design including lines plan, tank tests, hydrostatic calculation, strength calculation and classification plans were prepared. Based on these basic design results the shipyard was able to prepare the workshop and production documents. A similar philosophy for the co-operation between the shipyard and VOSTA LMG was used for the machinery design. All machinery functional diagrams and machinery system calculations and arrangements up to the level of class approval were executed by VOSTA LMG where the shipyard created the piping workshop documents. During the detail design period design evaluation meetings where held in China on a regularly basis to assure the required level of quality in the design.

The main dredging equipment as the essential part of the TSHD "Shen Hua" was designed, manufactured, delivered and installed under full responsibility of VOSTA LMG.

The shape and the equipment of the hopper represent new developments in the construction of hopper dredges. The hopper has a smooth geometry and the special design and arrangement of the loading boxes and the overflow weirs ensures a better settling of the very fine soil dredged in the Huanghua Port entrance. The "Shen Hua" can fulfill hers task in an economic manner, i.e. the amount of overflow losses could be reduced remarkably in comparison to other dredgers being employed in the same area.

In order to facilitate building in series, a number of dredging components such as side suction pipes, hoisting frames, bottom valves, overflow weirs, just to mention a few, are of a proven serial design. The lines of the ship, however, have been optimized to suit the respective application and the different propulsion and dredging concepts.

The Dredge Control & Monitoring System (DCMS) for the vessel has a control concept using various local interfaces. The ergonomically arranged operating panel includes the conventional operating elements as well as modern process control via screen, keyboard and trackball. Its special IT-structure allows control of the process from the main operating desk as well as from the bridge control desk.

Figure 14. The "Shen Hua's" dredge master desk.

The automation system visualizes and reports the entire dredging process. It controls the pumps and valves to ensure operation with maximum and continually optimized discharge rates. Amongst other parameters, the mixture concentration, mixture flow and pressure on the suction side are taken into account for optimization of the dredging process. Moreover, various automatic functions and sequences such as swinging out the side suction pipes, moving the valves into the required working mode etc. are of great help to the dredge-master to achieve quicker and safer operation. Besides the process visualizing system, a graphic side suction pipe position indicator shows the exact position of the side suction pipe. It is integrated into the entire system in the same way as the loading computer for exact monitoring of the loading condition of the TSHD.

1,500 kW CSD Presently Build in India

With a length of about 5,700 km the State of India has one of the most demanding coastlines in Asia. The necessary dredging activities at India's sea ports, fishing harbours and at the Indian navy are concentrated in the hands of the state-owned enterprise Dredging Corporation of India Limited (DCI). The company was established in 1976 with it's headquarter located in Visakhapatnam on the East-coast of India. Its fleet covers 10 trailing suction hopper dredges and two cutter suction dredges.

To achieve a potential growth in the company's turnover and revenue in the near future DCI has started to scout abroad for opportunities in the international dredging market such as in the Middle East and in the Far East. To support this ambitious plan a program to upgrade and extend DCI's existing dredge fleet was established. As part of this program, an order for DCI's largest ever built cutter suction dredger was placed with the Mumbai based Navy shipyard Mazagon Dock Limited MDL in October 2005.

Because MDL's experience in building dredges was only limited to grab hopper dredges and small size cutter dredges, a co-operation with VOSTA LMG as dredge designer and component supplier was set-up early in the tender period. As one of the company's philosophies, VOSTA LMG supplies the complete basic engineering package including all ship design classification documents, all machinery classification diagrams and drawings as well as the design for the electrical plant. All major dredging equipment is designed, manufactured and delivered to the shipyard. During the building period supervisors and service engineers provide the necessary support for the equipment installation and ensure the required quality of the dredger.

VOSTA LMG's component deliveries include amongst others the 400-ton cutter ladder, the complete working and holding spud system, the dredge pump and mixture pipe system, not to mention the sophisticated Central Integrated Information and Monitoring System (CIIMS) as "brain" for the cutter dredge control.

Main particulars of DCI's biggest CSD:

• Length over all	87.5	metres
• Breadth	16.0	metres
• Draught	3.0	metres
• Dredging depth	25.0	metres
• Cutter power	1,500	kilo Watts
• Total installed power	10,400	kilo Watts

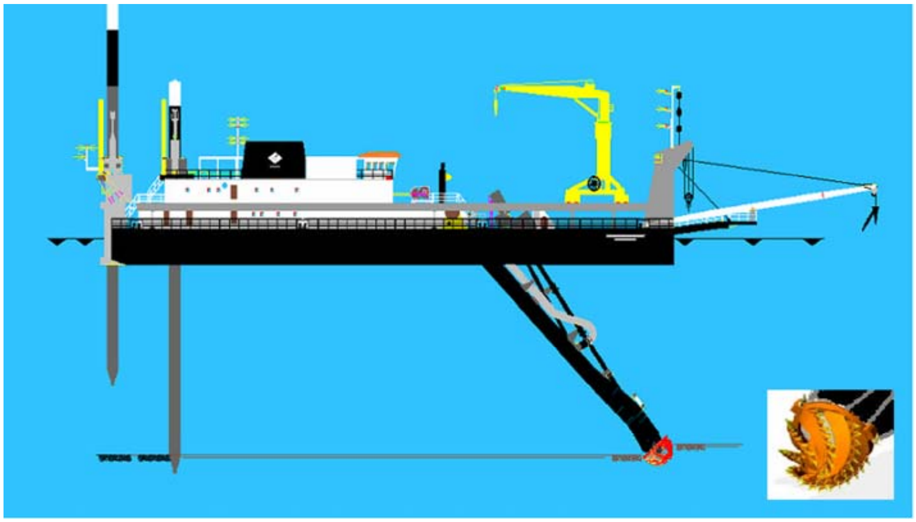


Figure 15. Artists impression of DCI's new CSD

To perform DCI's future dredging tasks, for instance the Sethusamudram Ship Channel Project, the new CSD will be equipped with an immense cutting power of 1,500 kW enabling the dredge to cut stones and corals having a shear strength of about 40 Mega Pascal. Highly efficient and economic dredging performance will be ensured through the implementation of a highly advanced cutter head design executed with VOSTA LMG's revolutionary T4-series third generation tooth system.

Figure 16.Cutter heads of DCI's new CSD

As an additional highlight, the vessel will be equipped with a sophisticated spud system enabling dredging in swell conditions under which most other modern CSD's are no longer able to operate.

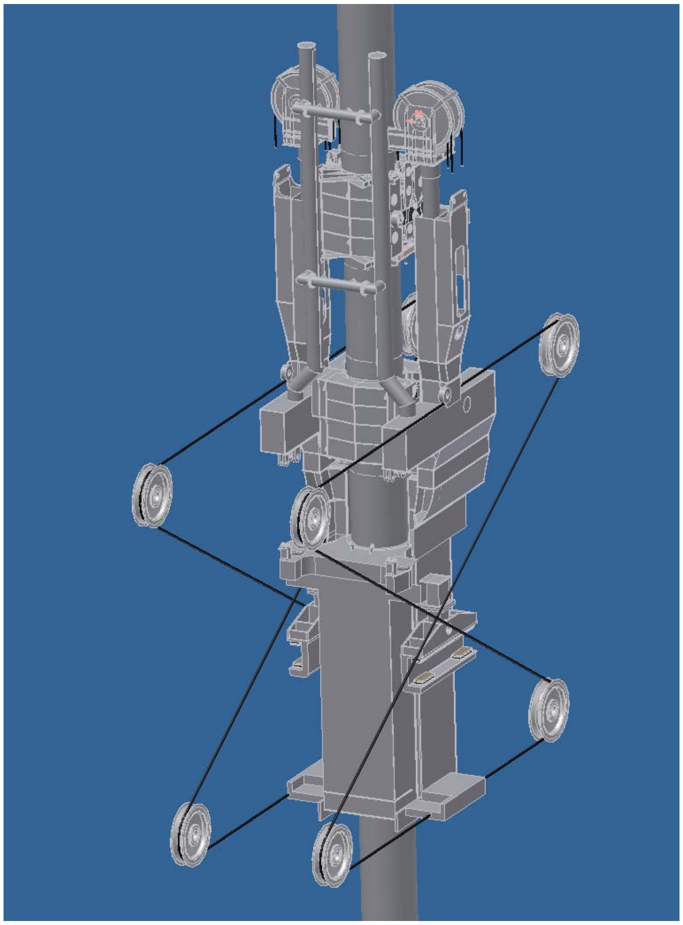


Figure17. Artist impression of VOSTA LMG's working spud system.

Consideration of Special National Boundaries in Building of Dredgers around the Globe.

TSHD "Liberty Island", Built in the USA under the Jones Act

The situation in the US dredging market is – in contradiction to the global dredging industry – characterised by a specific national boundary, called the Jones Act.

The Jones Act – or officially - the Merchant Marine Act was introduced in 1920. Per definition, it is a United States Federal statute that requires U.S.-flagged vessels to be built in the United States, owned by U.S. citizens, and documented under the laws of the United States. Documented means "registered, enrolled, or licensed under the laws of the United States." In addition, all officers and 75% of the crew must be U.S. citizens. Also the Jones Act restricts the carriage of goods between the different United States ports to U.S.-flagged vessels.

Vessels that satisfy these requirements comprise the "Jones Act fleet". This even applies to all dredges operating in U.S. territorial waters. In practise the Jones Act prevents the fleet of international dredge contractors from working in the territorial waters of the USA and U.S. dredging companies are not able to import state-of-the-art dredgers built on qualified foreign shipyards. But nevertheless, U.S. dredging companies have got access to the latest developments in dredging technology by combining the expertise and know-how of foreign dredge designing institutes and dredge equipment companies with the resources of capable local shipyards. This constellation was applied in building the 5,000 m^3 TSHD "Liberty Island" for the U.S. dredge contractor Great Lakes Dredge & Docks (GLD&D) in the year 2001.The vessel was built at the shipyard Bay Shipbuilding Co., Sturgeon Bay, WI based on a design and a key-component package delivered by VOSTA LMG, Germany. Up to now the TSHD "Liberty Island" represents the most modern dredger operating in U.S. territorial waters.

Figure 18. TSHD "Liberty Island" on sea voyage.

Main particulars:

• Length over all	99.06	metres
• Breadth	17.98	metres
• Draught loaded	7.01	metres
• Dredging depth	28.00	metres
• Hopper capacity	5,000	cubic metres
• Loading capacity	6,687	tons
• Total installed power	11,612	kilo Watts

The engineering package covered the following:

- All basic hull design documents (e.g. weight calculation, freeboard calculation, lines plan, intact and damage stability calculation, FEM-calculation, tank capacity table and arrangement plan)
- All classification hull steel structure drawings (mid-ship section, longitudinal sections, bulkheads, etc.)
- All classification machinery systems and diagrams (among others: power requirement calculation, electric load analysis, main engine arrangement plan, generator arrangement plan, machinery auxiliary systems plans)
- Design of the complete dredging equipment system
- Project management and supervision
- Preparation and partly execution of dredging and sea trails

Due to the special requirements of the Jones Act the equipment of the component packages was partly manufactured and/or finally assembled under VOSTA LMG's supervision and quality control at appropriate machinery workshops in the USA.

Among others following equipment was delivered:

- Dredge pumps
- Jet water pumps and jet water system components
- Side suction pipe system
- Mixture pipe system components including bow coupling
- Overflow weir system
- Bottom door system
- Unloading door system
- Hydraulic system as prime mover for the dredging equipment
- Integrated Dredge Control and Monitoring System (DCMS)

Figure 19. TSHD "Liberty Island on dredging service.

One of the mean features of the TSHD "Liberty Islands" is her state-of-the-art Dredge Control and Monitoring System. In a market where downtime really means a loss in profits, it is extremely frustrating when, in spite of the large investment in equipment, delays are caused and production time is lost as a result of operator errors. This is exactly the aspect of automation system design that was focused upon and developed to a high level. Resultantly the "Liberty Island" has a DCMS of this design. As well as including a whole range of automatic functions, the system guides the operator and controls his intentions in an unobtrusive way. At all times the operator has the feeling that he has complete control of the process.

Figure 20. Loading screen as part of "Liberty Island's" DCMS.

The safety and efficiency of this automation system is based among others on the following design criteria applied during the development phase:

- Clearly structured mimic pages
- Sequence controls
- Automatic functions
- Interlocks

TSHD "Mecca", built in Japan

More than 14,000 vessels with a dead weight up to 150,000 tons pass the Suez Canal every year. The Suez Canal Authority (SCA) as the representative of the Egyptian state expends great effort to maintain and improve this significant waterway. Besides continuous maintenance dredging works the canal is widened and deepened stage by stage in order to cope with the expansion in ship sizes. Huge infrastructure projects are being carried out and new harbors are under construction in Suez and Port Said, where a third sea entrance to the Suez Canal is being erected as well.

The Suez Canal Authority owns a notable dredging fleet which includes four Cutter Suction Dredges with a total installed power of more than 12,000 kW each and two TSHDs with a hopper capacity of 6,500 m^3. While the Cutters are mainly employed for deepening the canal, the Hoppers are at work maintaining the sea canals in the Port Said area. As one of SCA's company philosophies, their dredging fleet is continuously maintained, overhauled and renewed.

Part of this was the order of a new 10,000 m^3 Trailing Suction Hopper Dredger, which was awarded to the Kobe-branch shipyard of Japanese group Mitsubishi Heavy Industries (MHI) in September 2002. This order has set a new milestone in the long-lasting co-operation between SCA and MHI where this new dredge was the biggest TSHD ever built in Japan and represents number seven in the series of vessels delivered to the Suez Canal Authority.

Because MHI's experience in building modern state-of-the-art Trailing Suction Hopper dredgers lay some years in the past, the company sought a co-operation arrangement with a foreign dredge engineering and dredge component supplying company. A partnership was set-up with the Dutch-German dredge engineering and contracting company

VOSTA LMG at a very early stage in the project. Over the complete tender period of about two years, VOSTA LMG continuously supported MHI, especially in the design of the hopper loading and unloading system and the relevant dredging components.

With the placement of the order, which MHI won against strong competition, VOSTA LMG realized the chance to enter the Japanese shipbuilding market, which is dominated by the national maritime equipment supplying industry and heavily protected against foreign companies by means of high import taxes and national rules and regulations.

Figure 21. TSHD "Mecca" on rain bowing service.

For the new TSHD VOSTA LMG provided engineering assistance to MHI and acted as the supplier for the key dredging components such as dredge and jet pumps, trailing suction pipes with drag heads and hoisting equipment, an advanced dredge control and monitoring system, the hydraulic installation and the bow coupling system.

The design meets the specific requirements of SCA, combining the latest technical developments with well proven design principles. The execution of many components facilitates maintenance being performed local in Egypt.

SCA biggest TSHD is designed as a twin screw vessel with CPP and two free-hanging rudders. The deckhouse is arranged on aft ship and can accommodate up to 74 persons. The hopper is of the semi-closed type with centre box keelson and transverse saddles. The hopper load can be dumped through 20 conical bottom valves arranged in two rows or discharged via a bow coupling through a share pipeline.

Main particulars:

• Length over all	127.50	metres
• Breadth	26.00	metres
• Draught loaded	8.50	metres
• Dredging depth	35.00	metres
• Hopper capacity	10,000	cubic metres
• Loading capacity	16,000	tons
• Total installed power	31,020	kilo Watts

In the dredge there are two double-walled inboard dredge pumps installed. Be means of two jet pumps the hopper load can be diluted for discharging or rain bowing via the bow coupling system. For this operation purpose both dredge pumps can run in serial mode.

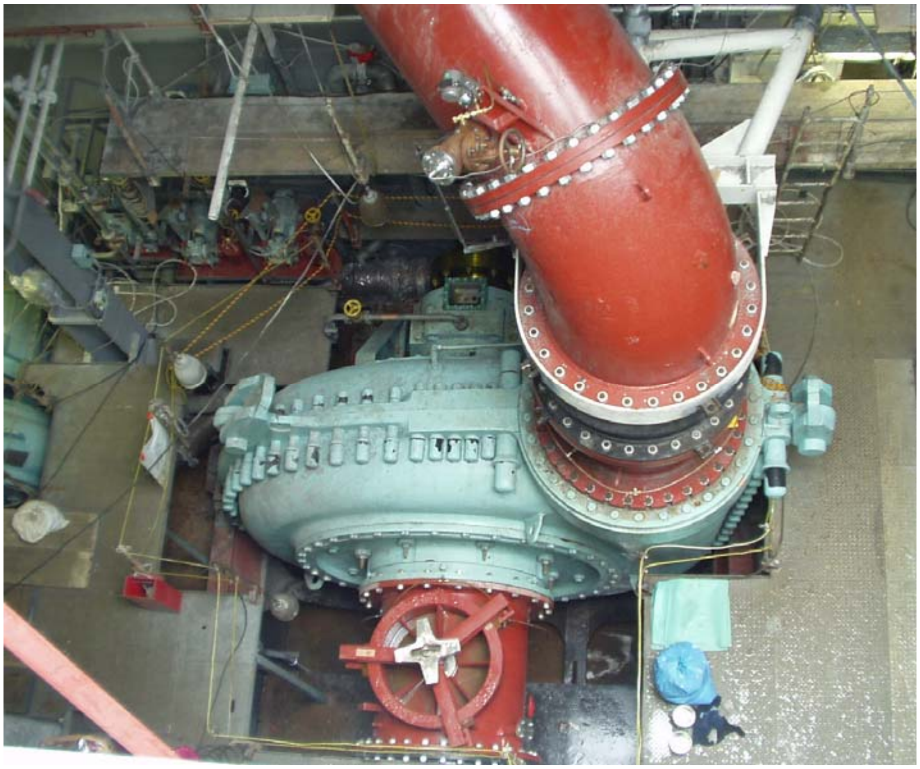


Figure 22. Top view to "Mecca's" PS-dredge pump.

To achieve high dredging efficiency in various kinds of soil SCA's new TSHD is equipped with two trailing suction pipes and drag heads of latest design.

Figure 23. Drag head with turbulence visor of TSHD "Mecca".

The whole dredging installation is controlled by a state-of-the-art Dredge Control and Monitoring System. The system is tailor made according to the special requirements of the Suez Canal Authority. Main features are the userfriendly human interfaces, the easy operation, the high functionality and the integrated automatic procedures for routine tasks.

CONCLUSIONS

Because of the enormous increase of global sea transport and the associated investment boost in the waterways and port infrastructures, a tremendous boom in worldwide dredging projects has been observed in recent years. Based on this the leading international dredge contractors have started a huge dredge fleet overhauling and renewal program, which is evident from the latest dredge new builds launched in the years 2005 and 2006.

At the same time, a new trend in building of modern and state-of-the-art dredgers and dredging equipment has surfaced. With the support of international dredge design institutes and dredge equipment suppliers developing countries have been able to establish their own dredging fleet based on the latest developments available in the market.

For a dredge designer and a dredge equipment supplier, this development opens new challenges and opportunities. By modifying its approach to the dredging business and carefully selecting areas of activity the company has been able to successfully adapt to this changing market. An important factor in this success has been the ability to integrate different nationalities, human characters and their cultures into the operational activities of the company.

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